# KS3 Science

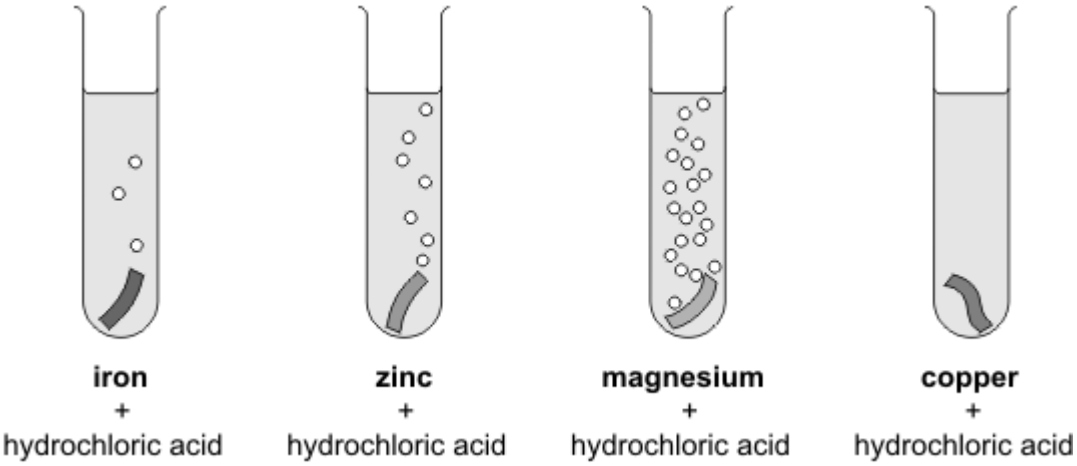
## Reactivity Series

### Question Paper

**Time available: 39 minutes**
**Marks available: 47 marks**

**1.** (a) Ruth put a piece of a different metal in each of four test tubes.

She poured 10 $cm^3$ of hydrochloric acid onto each metal.




Look at the diagrams above.

(i) How do these show if a metal reacts with the acid?

.....

1 mark

(ii) **On the lines below**, put the **four** metals in the order of how strongly they react with the acid.

**most reactive** .....

.....

.....

**least reactive** .....

1 mark

(b) Choose the name of a metal from the box below to answer each question.

| | | | |
|---|---|---|---|
| **copper** | **iron** | **magnesium** | **zinc** |

(i) Which metal from the box is used for electrical wires?

.....

1 mark

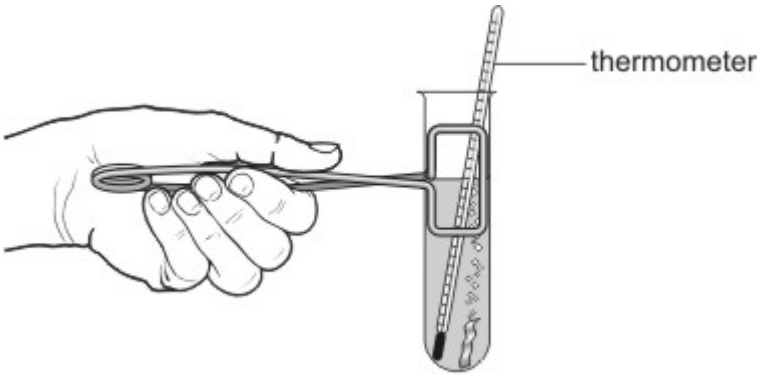
(ii) Which metal from the box goes rusty?

.....

1 mark

maximum 4 marks

**2.** Harry mixed zinc with copper sulphate solution in a test-tube.
A displacement reaction took place and the temperature increased.




(a) The word equation for the reaction is shown below.

zinc + copper sulphate → zinc sulphate + copper

Why is this reaction called a displacement reaction?

.....

.....

1 mark

(b) Harry repeated the experiment with two other metals.
He wanted to calculate the temperature rise each time.
His results are shown below.

| metal added to copper sulphate | temperature at the start (°C) | highest temperature reached (°C) | rise in temperature (°C) |
|---|---|---|---|
| zinc | 20.0 | 36.5 | 16.5 |
| iron | 25.5 | 38.5 | 13.0 |
| magnesium | 19.5 | 87.5 | 68.0 |

Harry used different starting temperatures.
Explain why this did **not** affect his results.

.....

.....

1 mark

(c) Part of the reactivity series of metals is shown below.

| | |
|---|---|
| **most reactive** | sodium |
| | calcium |
| | magnesium |
| | aluminium |
| | zinc |
| | iron |
| | lead |
| **least reactive** | copper |

Use the reactivity series above to answer all the questions below.

(i) Why was the highest rise in temperature obtained with magnesium and copper sulphate?

.....

.....

1 mark

(ii) Why was the rise in temperature obtained with zinc and copper sulphate **not** much higher than the rise in temperature obtained with iron and copper sulphate?

.....

.....

1 mark

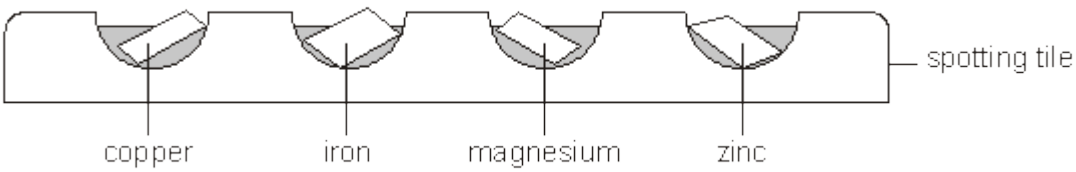
(iii) In which of the following mixtures would there be a rise in temperature? Write **yes** or **no** in each blank box.

| **mixture** | **Would there be a rise in temperature?** |
|---|---|
| aluminium + sodium chloride | |
| calcium + zinc sulphate | |
| lead + zinc chloride | |
| magnesium + iron chloride | |

2 marks

maximum 6 marks

**3.** (a) Sasha placed small samples of four different metals on a spotting tile.
She added drops of calcium nitrate solution to each metal.




Sasha repeated the experiment with:

- fresh samples of the four metals and copper nitrate solution
- fresh samples of the four metals and iron nitrate solution.

Will a reaction take place when each of the metals is added to each of the solutions?
Use the reactivity series below to help you.

**most reactive** calcium
magnesium
aluminium
zinc
iron
lead
**least reactive** copper

In the table below:

- place a tick, ✓, to show that a reaction took place
- place a cross, X, to show that **no** reaction took place.

Two have been done for you.

| **salt solution** | **metal** | | | |
|---|---|---|---|---|
| | **copper** | **iron** | **magnesium** | **zinc** |
| calcium nitrate | | | | |
| copper nitrate | X | | | |
| iron nitrate | | X | | |

3 marks

(b) Three pairs of chemicals are listed below.
A reaction only takes place with two of the pairs.

Draw a line from each reaction to the correct result.
Draw only **three** lines.

| pair of chemicals | result |
|---|---|
| calcium carbonate + hydrochloric acid | no reaction |
| magnesium + hydrochloric acid | a chloride, carbon dioxide and water are formed |
| copper + hydrochloric acid | a chloride and hydrogen are formed |

2 marks
maximum 5 marks

**4.** Part of the reactivity series of metals is shown below.

| | |
|---|---|
| **most reactive** | potassium |
| | sodium |
| | magnesium |
| | aluminium |
| | iron |
| | lead |
| **least reactive** | copper |

(a) Dan added a piece of magnesium to a solution of copper sulphate.
A displacement reaction took place.

The word equation for the reaction is shown below.

magnesium + copper sulphate → magnesium sulphate + copper

Why is this called a displacement reaction?

.....

.....

1 mark

(b) Look at each pair of chemicals in the table below.

Use the reactivity series to predict whether a displacement reaction would take place.
Write **yes** or **no** in the second column and give the reason for your decision.

| **pairs of chemicals** | **Does a displacement reaction take place? yes or no** | **reason** |
|---|---|---|
| iron + sodium chloride | | |
| magnesium + lead nitrate | | |

2 marks

(c) Dan wanted to find out where zinc should be placed in the reactivity series.

(i) What tests should Dan do to find the correct position of zinc in the reactivity series?

.....

.....

.....

1 mark

(ii) How would Dan use his test results to decide where to put zinc in the reactivity series?

.....

.....

.....

1 mark
maximum 5 marks

**5.** (a) The table below shows the melting points of four metals.

| metal | melting point, in °C |
|---|---|
| gold | 1064 |
| mercury | –37 |
| sodium | 98 |
| iron | 1540 |

(i) Which metal in the table has the highest melting point?

.....

1 mark

(ii) Which metal in the table has the lowest melting point?

.....

1 mark

(b) Gold can be a **gas** or a **liquid** or a **solid.**

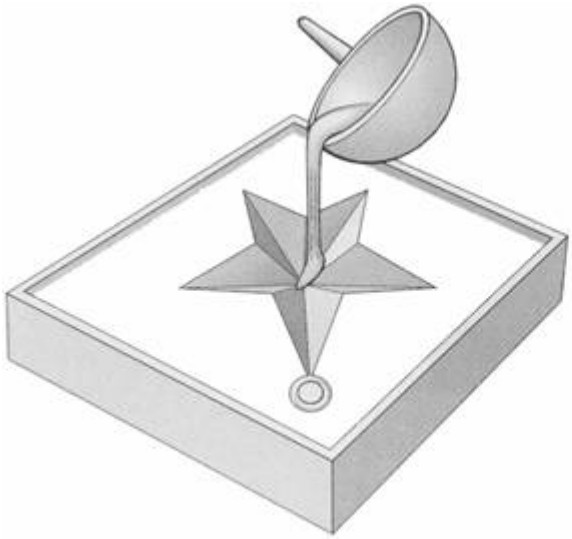
Choose from these words to fill the gaps below.

When gold is heated from room temperature to 1070°C, the gold

changes from a ..... to a ..... .

1 mark

(c) 5 g of gold is melted and **all** of it is poured into a mould to make a pendant as shown below.



melted gold is poured into a mould

gold pendant

What is the mass of the gold pendant?

..... g

1 mark

(d) The table below shows how the four metals react with oxygen when heated in air.

| **metal** | **reaction when heated in air** |
|---|---|
| gold | no change |
| mercury | slowly forms a red powder |
| sodium | bursts into flames straight away |
| iron | very slowly turns black |

(i) Which is the **most** reactive metal in the table?

.....

1 mark

(ii) Which is the **least** reactive metal in the table?

.....

1 mark

Maximum 6 marks

**6.** Many metals have to be extracted from compounds called ores.

(a) The table shows a reactivity series.

| Reactivity | Material |
|---|---|
| Most reactive | potassium |
|  | sodium |
| | magnesium |
| | aluminium |
| | carbon |
| | zinc |
| | lead |
| | hydrogen |
| | copper |
| Least reactive | gold |

Use the information in the table to help you answer the questions.

(i) Give the method used to extract sodium from its ore.

.....

**(1)**

(ii) Name **one** metal in the table that can be extracted by heating the ore with carbon.

.....

**(1)**

(iii) Copper can be extracted by heating the ore with hydrogen.

Use the table to explain why.

.....

.....

**(1)**

(b) Iron is made by heating iron ore (iron oxide, $Fe_2O_3$) with carbon monoxide (CO) in a blast furnace.

(i) Describe how the carbon monoxide is produced in the blast furnace.

.....

.....

.....

.....

**(2)**

(ii) Write a balanced symbol equation for the reaction between iron oxide and carbon monoxide.

.....

**(3)**

(iii) The production of iron from iron ore involves both oxidation reactions and reduction reactions. Explain why.

.....

.....

.....

.....

**(2)**

**(Total 10 marks)**

**7.** Railway lines can be joined together by pouring molten iron into the gap between them.

(a) The molten iron is produced by the reaction between powdered aluminium and iron oxide. Complete the word equation for the reaction.

aluminium + iron oxide → iron + …….

1 mark

(b) Iron can be produced from a mixture of aluminium and iron oxide but **not** from a mixture of copper and iron oxide.
Write the names of the **three** metals, in the order of their reactivity.

most reactive …….

…….

…….

1 mark

(c) The list shows the names and symbols of five metals in order of their reactivity.

| name | symbol |
|---|---|
| sodium | Na |
| calcium | Ca |
| magnesium | Mg |
| zinc | Zn |
| silver | Ag |

(i) What, if anything, would be the result of heating zinc powder with calcium oxide?

… … … … … … … … … … … … … … … … . … … … … … …

1 mark

(ii) Write down the **name** of a metal in the list that will **not** react with a solution of magnesium sulphate.

… … … … … … … … … … .

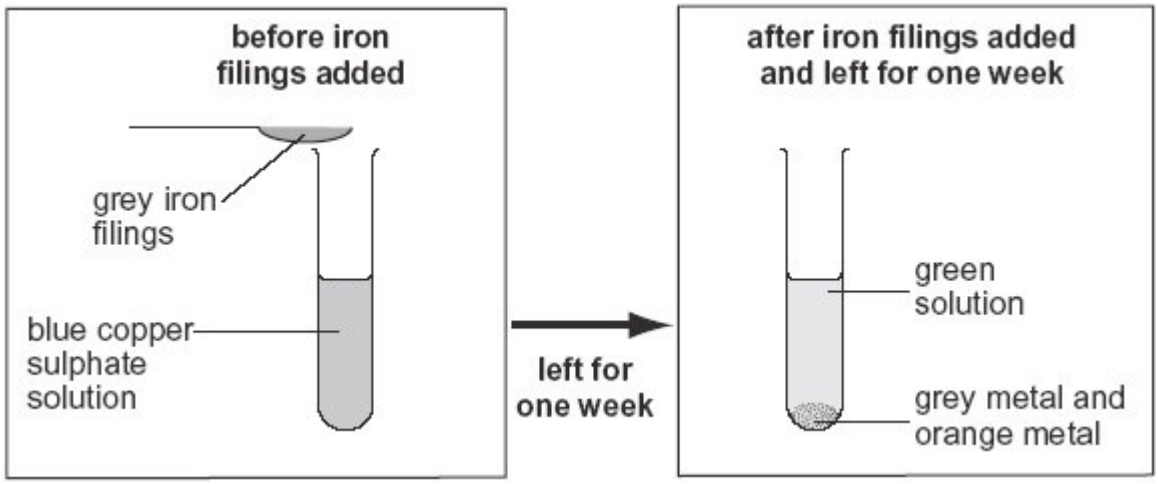
1 mark

(d) The powdered metal with the symbol Zn burns in air.
Write the **word equation** for the reaction.

… … … … … … … … … … … … … … … … … … … … … … … … …

2 marks
Maximum 6 marks

**8.** Joanne added iron filings to copper sulphate solution.
She observed the reaction after one week.




(a) What evidence in the diagrams shows that a chemical reaction has taken place?

.....

1 mark

(b) The reaction between iron and copper sulphate is a **displacement** reaction.

(i) Give the name of the orange metal visible after one week.

.....

1 mark

(ii) What is the name of the compound formed in this reaction?

.....

1 mark

(iii) Joanne poured the green solution into another test tube. She added some copper pieces to the solution.

Will a displacement reaction occur?

yes ☐ no ☐

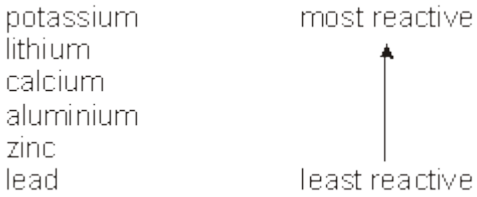
Explain your answer.

.....

.....

1 mark

(c) Part of the reactivity series of metals is shown below.




Use the information above.
Which **two** metals would react with aluminium nitrate in a displacement reaction?

Tick the **two** correct boxes.

calcium ☐ potassium ☐

zinc ☐ lead ☐

1 mark
maximum 5 marks